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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
| 10/693,373 | 10/24/2003 | Yan Borodovsky | 10559-882001/P17484 | 2788 |
| 20985 7590 07/11/2008 FISH & RICHARDSON, PC P.O. BOX 1022 MINNEAPOLIS, MN 55440-1022 | | | | |
| EXAMINER | | | | |
| CHACKO DAVIS, DABORAH | | | | |
| ART UNIT | | PAPER NUMBER | | |
| 1795 | | | | |
| MAIL DATE | | DELIVERY MODE | | |
| 07/11/2008 | | PAPER | | |

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte YAN BORODOVSKY

Appeal 2008-3520
Application 10/693,373
Technology Center 1700

Decided: July 11, 2008

Before EDWARD C. KIMLIN, ROMULO H. DELMENDO, and
JEFFREY T. SMITH, *Administrative Patent Judges*.

KIMLIN, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal from the final rejection of claims 1-13 and 25-27.
Claims 1 and 10 are illustrative:

1. A system comprising:

a first apparatus to radiate an interference pattern of lines and spaces on a photoresist, the lines having a substantially equal first width and remaining unexposed to radiation, the spaces being exposed to radiation; and

a second apparatus to radiate selected areas of the photoresist, the selected areas exposing portions of the lines to radiation, wherein a pitch of the selected areas exposed by the second subsystem is at least one and a half times a pitch of the interference pattern; and

an alignment apparatus to align the selected areas radiated by the second apparatus with the interference pattern radiated by the first apparatus to trim and narrow the first width of at least some of the lines.

10. A method comprising:

forming an interference pattern of non-exposed lines and exposed spaces on a photoresist, the lines having a first width;

exposing a portion of at least one line to radiation to form features with a second width, the second width being less than the first width, wherein a pitch of the features is at least one and a half times a pitch of the interference pattern.

The Examiner relies upon the following references in the rejection of the appealed claims:

| | | |
|--------|-----------------|--------------|
| Brueck | 5,415,835 | May 16, 1995 |
| Sugita | EP 0 915 384 A2 | May 12, 1999 |

Appellant's claimed invention is directed to a system and method of irradiating selected areas of a photoresist to an interference pattern and a second pattern using, for example, a mask-based or maskless optical lithography tool or an electron beam lithography tool.

Appealed claims 10-12 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Sugita. Claims 1-3, 5, 7, and 25-27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Sugita in view of Brueck.

We have thoroughly reviewed each of Appellant's arguments for patentability. However, we find that the Examiner's rejections are well-founded and supported by the prior art evidence relied upon. Accordingly, we will sustain the Examiner's rejections for the reasons set forth in the Answer, and we add the following primarily for emphasis.

We consider first the § 102 rejection of claims 10-12 over Sugita. As set forth by the Examiner, Sugita, like Appellant, discloses a method of irradiating a photoresist to interference patterns to form line and space patterns on the photoresist, and performing a second exposure with a different apparatus to form a pattern having a pitch twice as large as the first pitch of the interference pattern. Also, as explained by the Examiner, Sugita illustrates in Figures 7A and 7B that, when using a positive photoresist wherein the exposed areas are removed, the second line width of the line and space pattern is less than the width of the line of the first non-exposed area formed by the first interference exposure (*see* Ans. 6-7). In other words, the width of the unexposed area depicted on Figures 7A to the right of the shaded area is less than the width of the unexposed area depicted in Figure 7B to the right of the shaded area.

Appellant attempts to distinguish the claimed method over Sugita by stating that Sugita is directed to multiplex exposure amounts with three or more exposure levels, as contrasted with the two exposure levels of a binary exposure level system. Appellant cites paragraph [0032] of Sugita for an acknowledgement that a single exposure process results in two exposure levels. However, as emphasized by the Examiner, paragraph [0020] of Sugita expressly discloses "performing a first exposure process by use of interference fringe produced by interference of two light beams; and

performing a second exposure process by use of a light pattern different from the interference fringe; wherein, in at least one of the first and second exposure processes, a multiplex exposure amount distribution is provided" (emphasis added). Hence, to the extent Appellant is focusing upon the multiplex exposure of Sugita, Sugita teaches that only one of the first and second exposure processes may be multiplex. Since Sugita clearly teaches a combination of a dual-beam interference exposure and an ordinary (projection exposure on a positive photoresist (*see* paragraph [0038]), we agree with the Examiner that Sugita describes within the meaning of § 102 the claimed method of forming an interference pattern of non-exposed lines on a photoresist and exposing a portion of a line on the photoresist to unspecified radiation. We note that claims 10-12 do not recite any particular type of exposure technique in paragraph two.

We do not understand Appellant's statement that "FIG. 7B [of Sugita] shows the complete exposure of the line that is not exposed by an interference exposure process" (Reply Br. 3, second para.). Sugita expressly states that Figure 7B results "[w]hen the projection exposure process for defining the exposure pattern of Figure 7A is performed, after dual-beam interference exposure process of Figure 5 without development process, superposedly to the same region of the same resist . . . " ([0071]). Hence, Sugita teaches that Figure 7B illustrates exposure to both an interference pattern and an ordinary projection exposure.

We now turn to the Examiner's § 103 rejection of claims 1-3, 5, 7, and 25-27 over Sugita in view of Brueck. We fully concur with the Examiner that Brueck evidences the obviousness of modifying the exposure system of Sugita such that the projection exposure is aligned in order to trim

and narrow the width of the lines produced by the interference pattern. Brueck specifically claims a second exposure positioned relative to a first interference pattern such that every other unexposed region of the interference pattern is exposed (claim 10, sub b), and Brueck also teaches that "[d]esired regions of the complex pattern thus produced are isolated with a further exposure of the photosensitive layer using any conventional lithography" (Abstract). Indeed, as pointed out by the Examiner, Sugita teaches that the line width of the interference pattern can be reduced by adjusting the angles of the exposing radiation, thereby suggesting the use of the presently claimed alignment apparatus (*see* Sugita at [0074] and [0086]).

Appellant maintains that "Brueck's crossed grating patterns neither describe nor suggest trimming and narrowing a width of at least some of the non-exposed lines of an interference pattern by exposing portions of the non-exposed lines using a second exposure, as recited in claim 24" (Principal Br. 11, second para.). First, we note that claim 24 has been canceled. Second, the second claimed exposure recited in claims 1 and 25 do not preclude the exposure of an interference pattern. Third, as explained above, Brueck teaches a further exposure using conventional lithography. Also, as explained by the Examiner, Brueck's second exposure in fact trims the line width from 0.5 microns to 0.1 microns (*see* Ans., para. bridging pages 8-9). In addition, the Examiner does not cite Brueck for its crossed grating patterns since the reference is not so limited. The Examiner cites Brueck for teaching that the two-dimensional pattern can be either interconnected or unconnected (col. 2, ll. 43-46), and for the disclosure of a second exposure which trims the width of unexposed lines.

We are also not persuaded by Appellant's argument that "Brueck fails to describe or suggest that these areas are to be aligned using an alignment apparatus" (Principal Br. 15, first para.). Brueck clearly teaches that "[i]n view of the close tolerances involved in producing patterns and microelectronic integrated circuits in accordance with the present invention, accurate alignment and position sensing is important" (col. 2, ll. 62-65). As for Appellant's argument that "Brueck describes that the *entire width* of a non-exposed line can be exposed using conventional lithography techniques" (Principal Br. 15, second para.), trimming the entire width of a line can be fairly considered to be an ultimate form of trimming. Moreover, we are convinced that one of ordinary skill in the art would have found it obvious to trim all or only a portion of an unexposed line, as desired. Also, we agree with the Examiner that one of ordinary skill in the art would have considered it obvious to employ an alignment apparatus to expose the areas of the resist desired.

As a final point, we note that Appellant bases no argument upon objective evidence of nonobviousness, such as unexpected results, which would serve to rebut the inference of obviousness established by the applied prior art.

In conclusion, based on the foregoing and the reasons well stated by the Examiner, the Examiner's decision rejecting the appealed claims is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv)(effective Sept. 13, 2004).

AFFIRMED

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